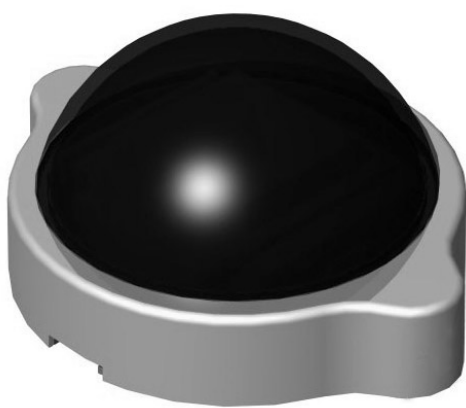


*Sapphire*

**GPS Receiver**

User Manual



RGM-2000

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## What Is Sapphire ?

Congratulation on your purchase of Sapphire, offering diverse GPS (Global Positioning System) applications. Sapphire represents the latest ingenious GPS technology from the leading GPS receiver manufacturer. Connecting to the notebook PC implementing a map or navigation software, Sapphire helps you locate one or multiple objects, conduct personal & vehicle navigation, and/or apply for geographical surveys.

## What Is Inside ?

Before you start up, make sure that your package includes the following items. If any items are missing or damaged, contact RoyalTek immediately. Please refer to the contact information on the last page of this manual.

◆GPS Receiver ◆ Cable(RS-232 or USB)

◆CD Disc

## What Is GPS ?

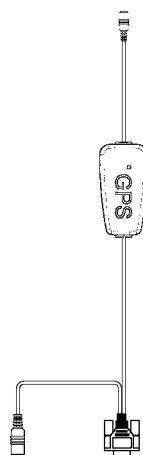
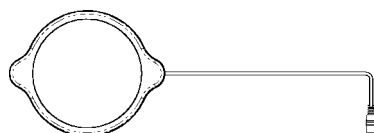
In 1974 the USA Department of Defense set about developing a Global Positioning System (GPS), a constellation of 24 satellites that Orbits 12,000 miles above the Earth. Using triangulation of signals from four of the satellites, a receiving unit on earth can pinpoint its current location to within a few meters. A GPS device receive the data, then convert the longitude, latitude, and altitude (LLA) data into a location point. Position and navigation information is vital to a wide range of professional and recreational activities covering surveying, search and rescue, tracking, hiking, navigating, and so forth.

## What Have Inside the Package?

Before you start up, make sure your package includes the following items. If any item is missing or damaged, contact your dealer immediately. Please refer to the contact information on the last page of this manual.

- ◆ GPS Receiver
- ◆ Application CD
- ◆ Cable for RS232 or USB (depending on what you buy)

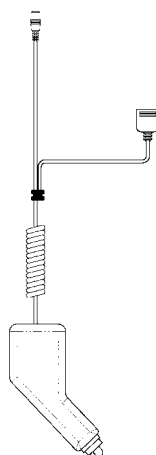
RGM-2000M



RS-232/Ps2



USB



Car cigarette adaptor  
12V

### PDA cable selection:

HP iPaq series  
Casio series  
HP Jornada series  
Fujitsu-Siemens LOOX Series  
O2 XDA Series

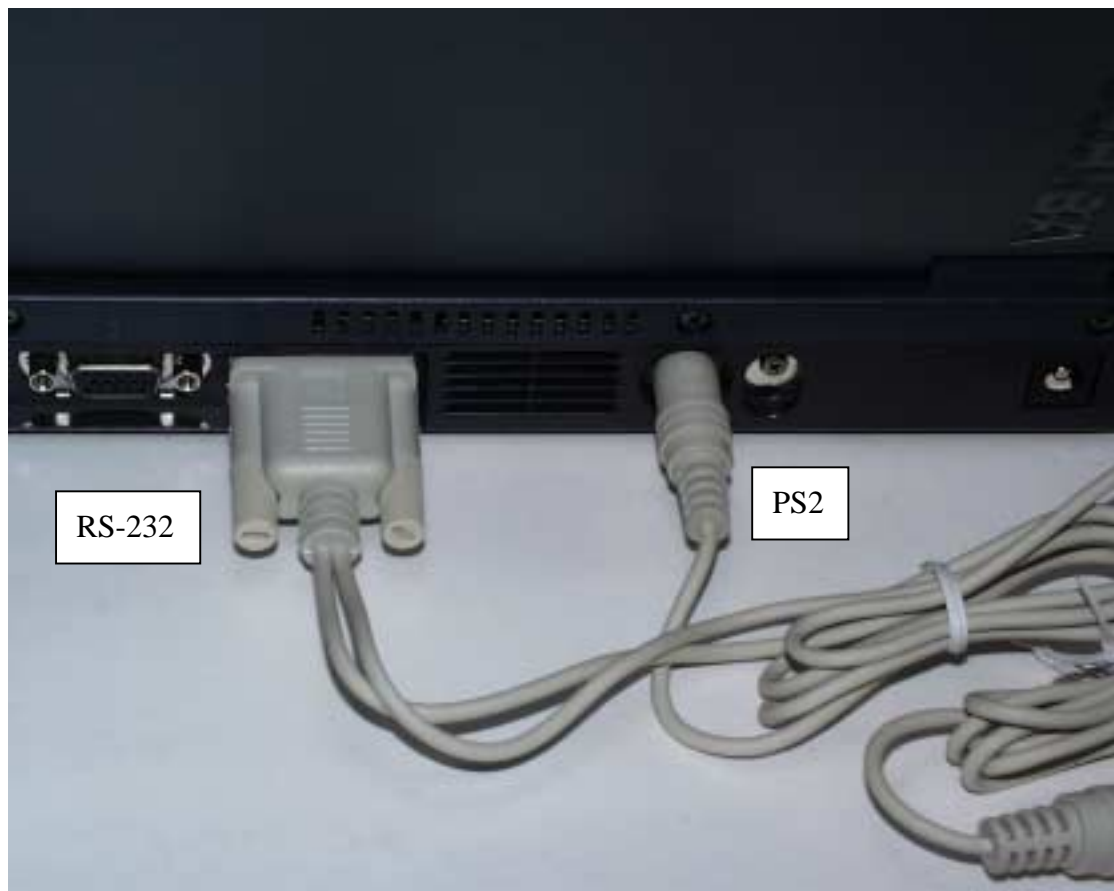
**\*Other various PDA cables :  
Please refer to our web site.**

# How to Install & Operate Sapphire ( RS-232 ) ?

## Getting Started

Step 1: Plug RS-232 to COM port of your Notebook PC or Handheld PC.

Step 2: Plug PS2 connector in the PS2 mouse outlet of your Notebook PC or Handheld PC.



Step 3:Place your Sapphire on the outside roof of your vehicle with magnetic base.

Step 4:Power on your Notebook PC or Handheld PC. If you have ordered a cigarette adaptor, please plug the cigarette adaptor into the cigarette outlet of the car.

Step 5:Choose the correct COM port for running the map or navigation software.

Step 6:Run the Sapphire test program. Please refer to “**How to test your Sapphire**”.

Notice:

- (1) Make sure the power is off before started.
- (2) For safety reason, please do not install Sapphire while driving.
- (3) To receive NMEA0183 navigational data, please use the Hyper Terminal program of Windows95/98<sup>®</sup>/ME<sup>®</sup>/2000<sup>®</sup>. Please setup the COM port connected with Sapphire to:

|              |         |
|--------------|---------|
| Baud rate    | : 4800  |
| Data bit     | : 8     |
| Parity       | : None  |
| Stop bit     | : 1     |
| Flow control | : None. |
- (4) The formats of NMEA messages are illustrated on Software Data section.
- (5) To prevent from the poor contact, the 4-pin mini din connector was designed as good fitting. It is strongly recommend that user doesn't plug and unplug this connector frequently.

# How to Install & Operate Sapphire ( USB ) for Windows 98®?

## Getting Started

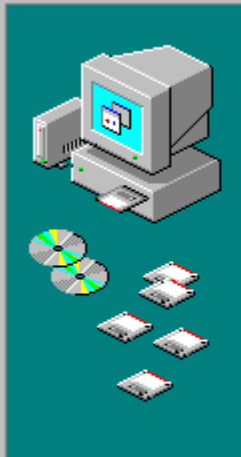
Step 1: Plug USB connector to USB port of your Notebook PC or Handheld PC.

Step 2: After plug in the Sapphire, it will automatically detect the hardware and show up pop-up dialog as follows. Click “**Next>**” button.



Assert the “Search for the best driver for your device”. Click “**Next>**” button.

## Add New Hardware Wizard



What do you want Windows to do?

- ☒ Search for the best driver for your device.  
(Recommended).
- ☐ Display a list of all the drivers in a specific location, so you can select the driver you want.

< Back

Next >

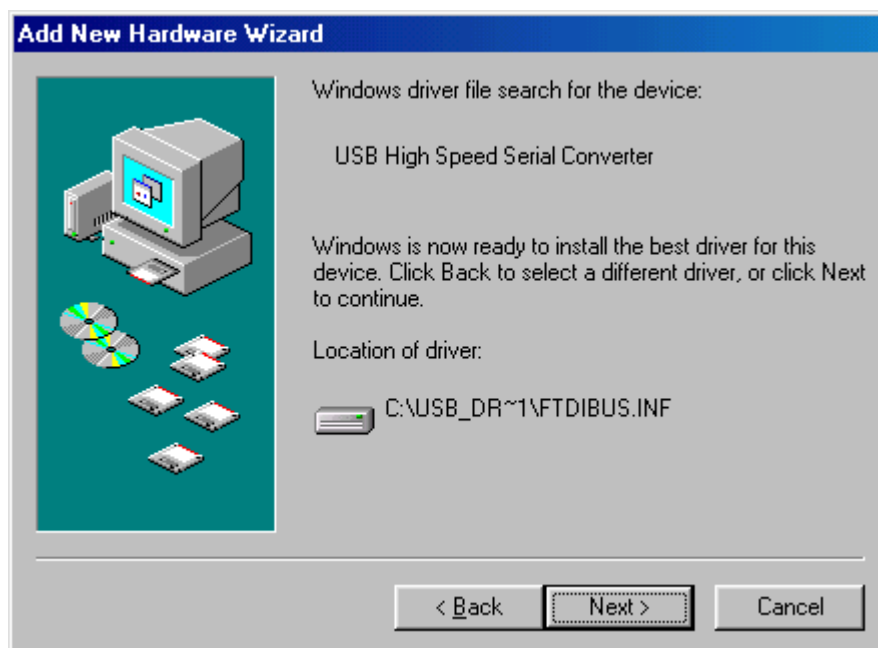
Cancel



Please assert the “Specify a location” and select the correct directory of the driver,  
”\USB\_DRIVER” in CD-Disc. Click the “Next>” button.



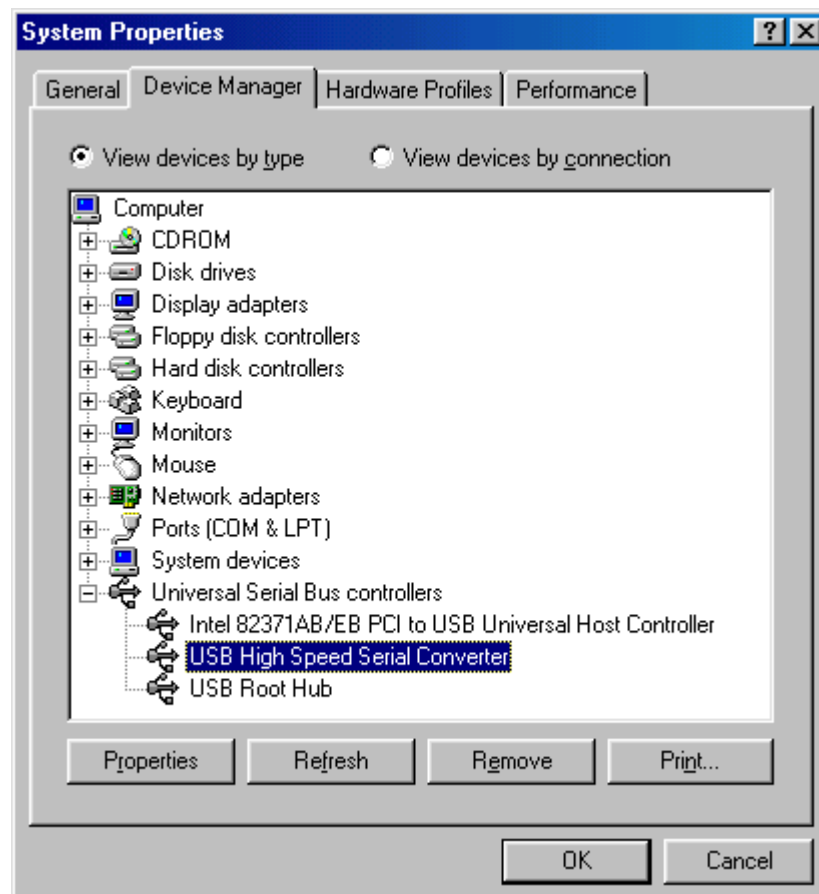
It will find the driver from the CD-Disc automatically. Click “Next>” button.



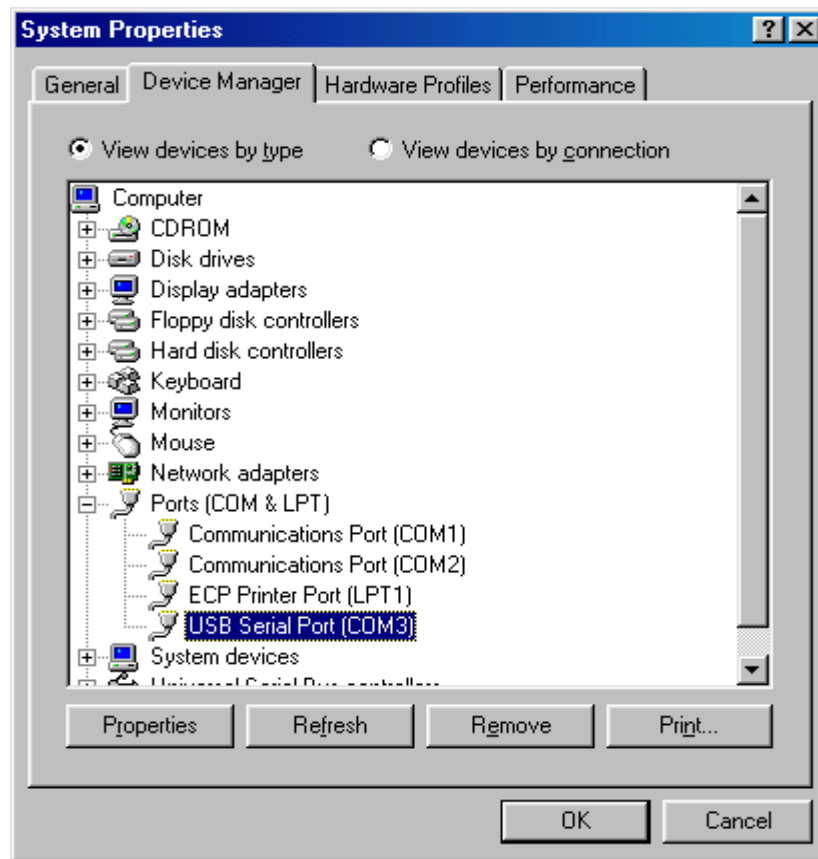
The USB Serial converter driver is installed now.



You can check the COM port number of Sapphire from the System properties now.



The default COM port is COM3 in this example.



Step 3: Place your Sapphire on the outside roof of your vehicle with magnetic base.

Step 4: Power on your Notebook PC or Handheld PC.

Step 5: Choose the correct COM port for running the map or navigation software.

Step 6: Run the Sapphire test program. Please refer to “**How to test your Sapphire**”.

Notice:

- (1) Make sure the power is off before started.
- (2) For safety reason, please do not install Sapphire while driving.
- (3) To receive NMEA0183 navigational data, please use the Hyper Terminal program of Windows 95/98<sup>®</sup>. Please setup the COM port connected with Sapphire to:

|              |         |
|--------------|---------|
| Baud rate    | : 4800  |
| Data bit     | : 8     |
| Parity       | : None  |
| Stop bit     | : 1     |
| Flow control | : None. |

- (4) NMEA 0183 data formats are illustrated on Software Data section.
- (5) To prevent the poor contact, the 4-pin mini din connector was designed as good fitting. We strongly recommend user that do not plug and draw this connector frequently.

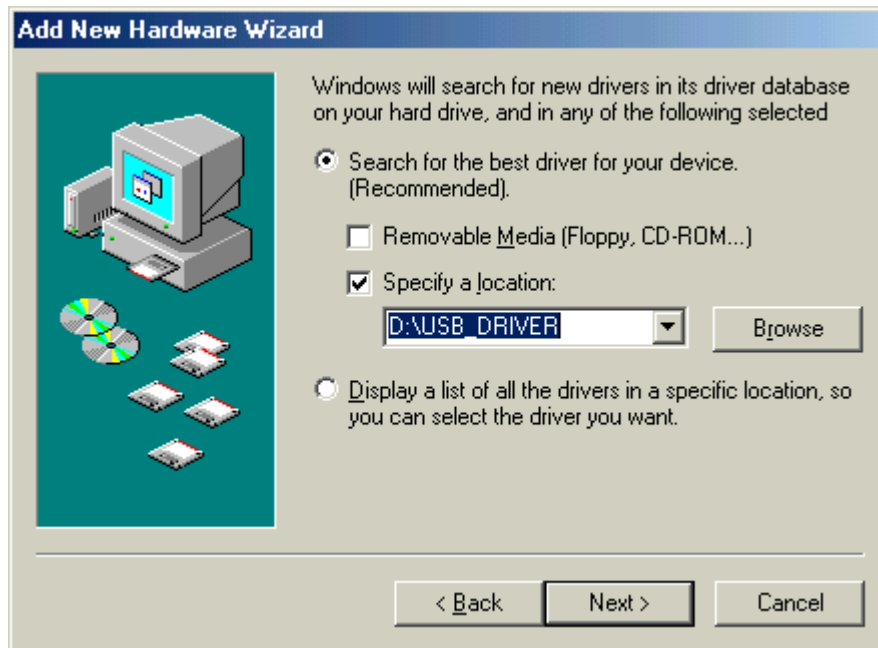
# How to Install & Operate Sapphire ( USB ) for Windows Me®?

Step 1: Plug USB connector (①) to USB port to your Notebook PC or Handheld PC.

Step 2: After plug in the Sapphire, it will detect the hardware automatically. Click the “**Next>**” button.



Please insert the “Specify a location” and select the correct directory of the driver in CD-Disc, “\USB\_DRIVER”. Click the “**Next>**” button.



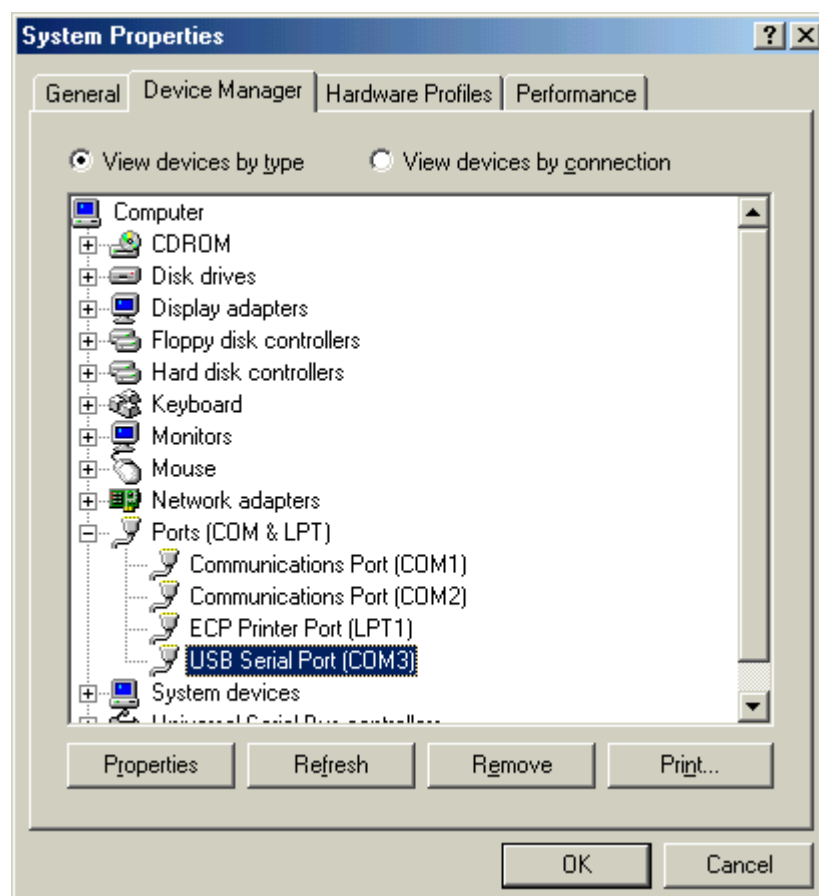
Windows Me will search and find the USB serial driver. Click “**Next>**” button.



The USB Serial converter driver is installed now.



You can check the COM port number of Sapphire from the System properties now.



Step 3:Place your Sapphire on the outside roof of your vehicle with magnetic base.

Step 4:Power on your Notebook PC or Handheld PC.

Step 5:Choose the correct COM port for running the map or navigation software.

Step 6:Run the Sapphire test program. Please refer to “**How to test your Sapphire**”.

Notice:

(1) Make sure the power is off before started.

(2) For safety reason, please do not install Sapphire while driving.

(3) To receive NMEA0183 navigational data, please use the Hyper Terminal program of Windows Me<sup>®</sup>. Please setup the COM port connected with Sapphire to:

|              |         |
|--------------|---------|
| Baud rate    | : 4800  |
| Data bit     | : 8     |
| Parity       | : None  |
| Stop bit     | : 1     |
| Flow control | : None. |

(4) NMEA 0183 data formats are illustrated on Software Data section.

(5) To prevent the poor contact, the 4-pin mini din connector was designed as good fitting. We strongly recommend user that do not plug and draw this connector frequently.



# How to Install & Operate Sapphire ( USB ) for Windows 2000®?

Step 1: Plug USB connector (①) to USB port to your Notebook PC or Handheld PC.

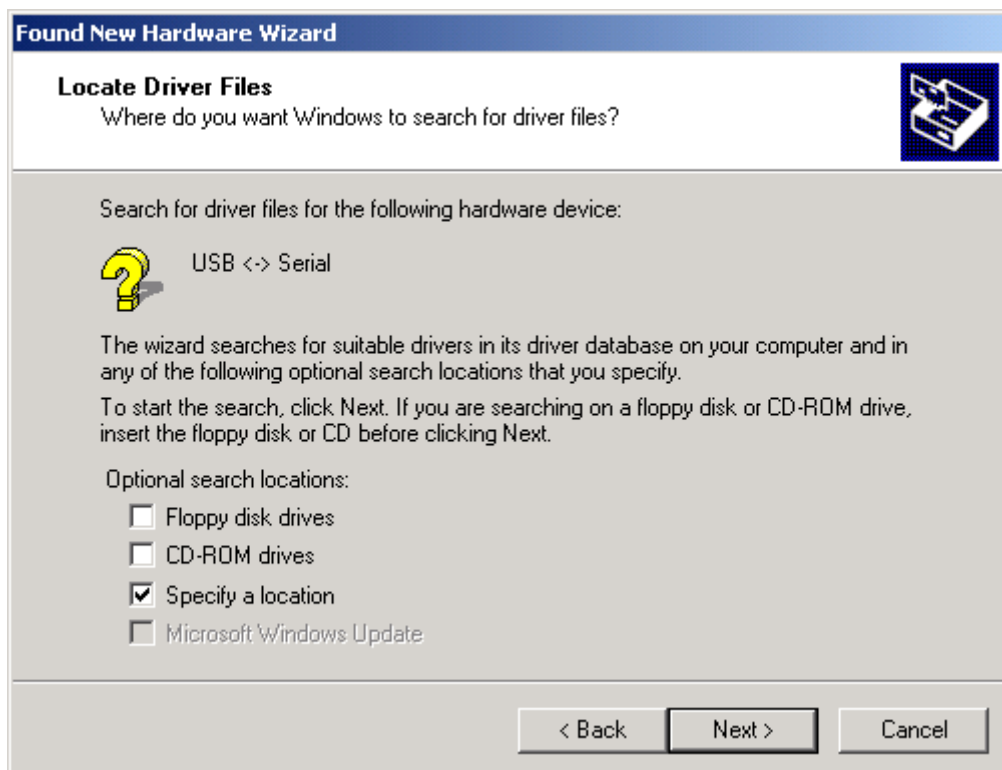
Step 2: After plug in the Sapphire, it will detect the hardware automatically. Click the “**Next>**” button.



Please select “Search for a suitable driver for my device”. Click “**Next>**” button.

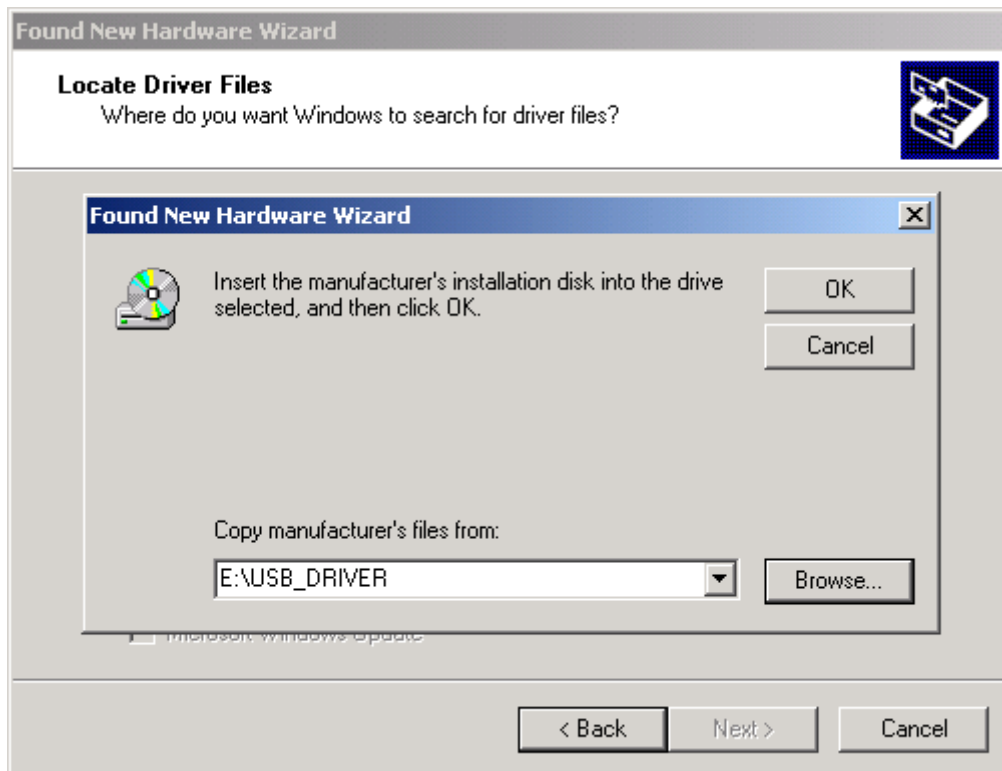


Please select the “Specify a location”. Click “**Next>**” button.

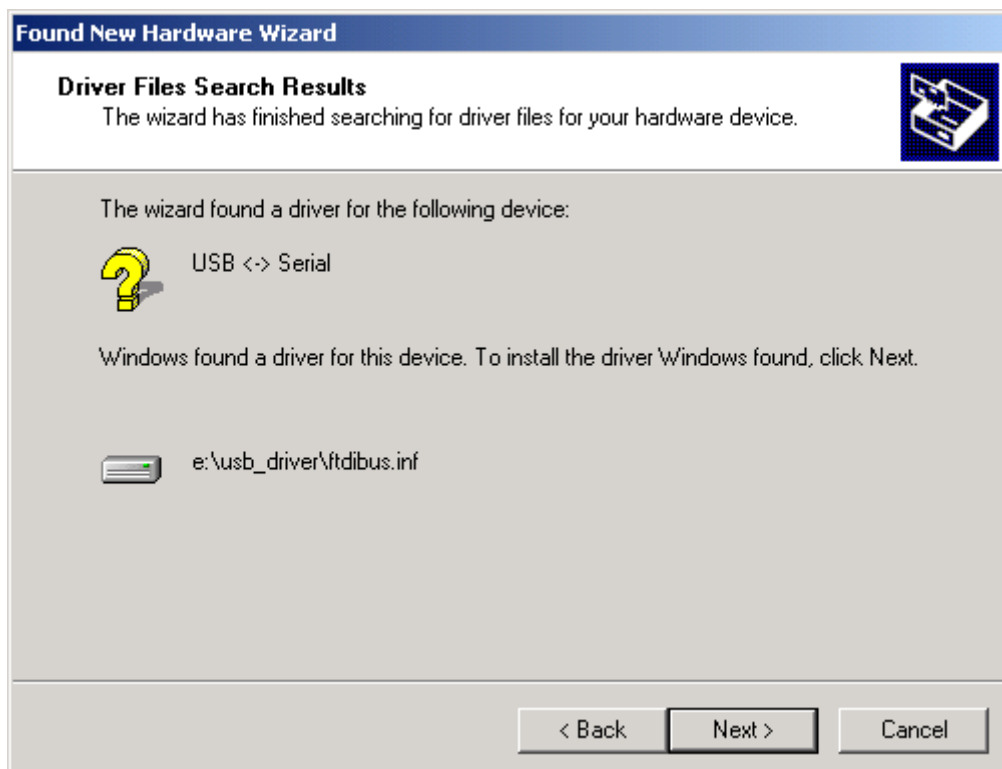


Please browse the CD-Disc and select the directory, “\USB\_DRIVER”.

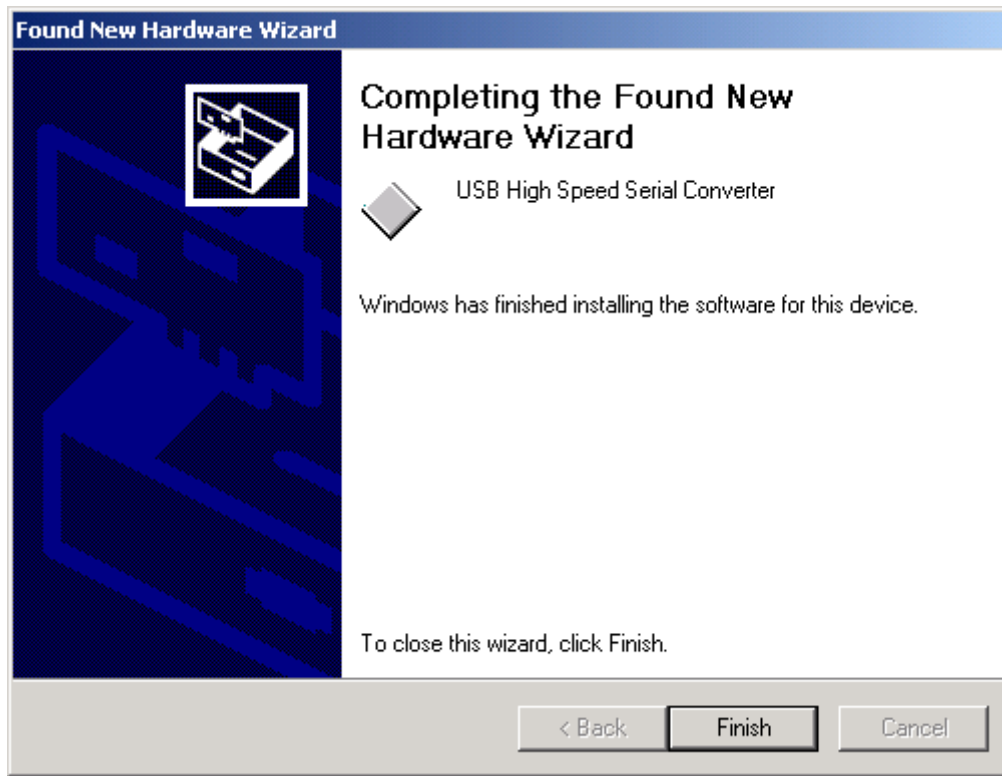
Click “OK” button.



Windows 2000 will find the USB Serial converter device. Click the “Next>” button.



The USB Serial driver is installed in Windows 2000® now.



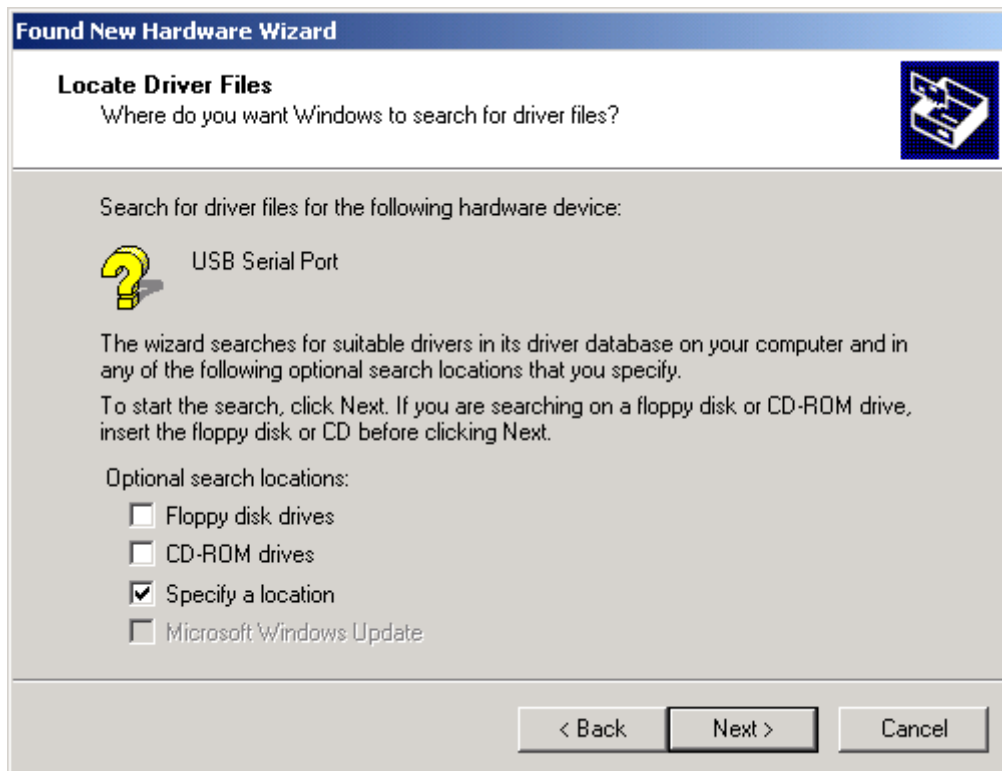
It will setup the USB Serial port driver for Sapphire. Please click “**Next>**” button.



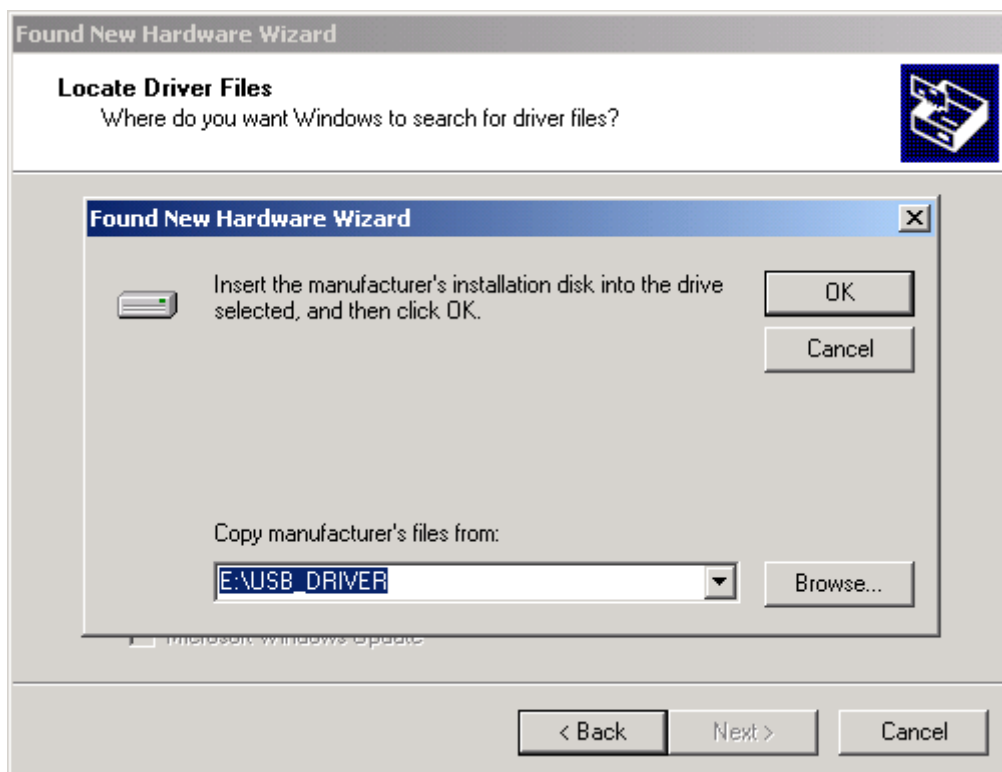
Please select the “Search for a suitable driver for my device”. Click “**Next>**” button.



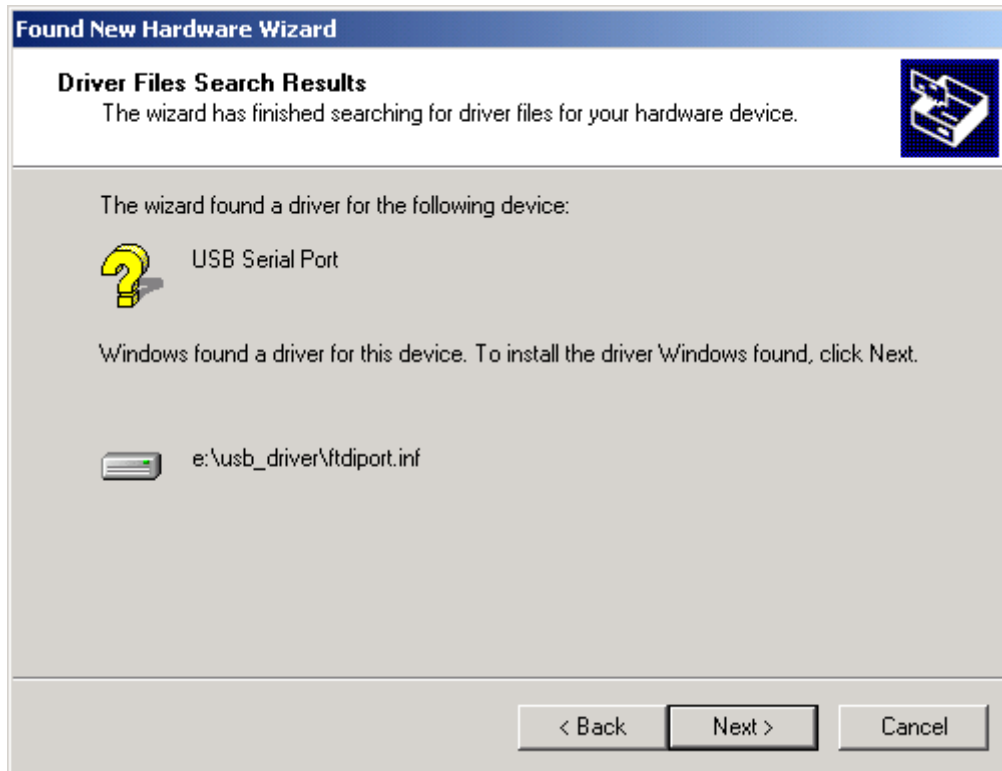
Please select the “Specify a location”. Click “**Next>**” button.



Please select the directory of the Sapphire, “\USB\_DRIVER”. Click “**OK**”.



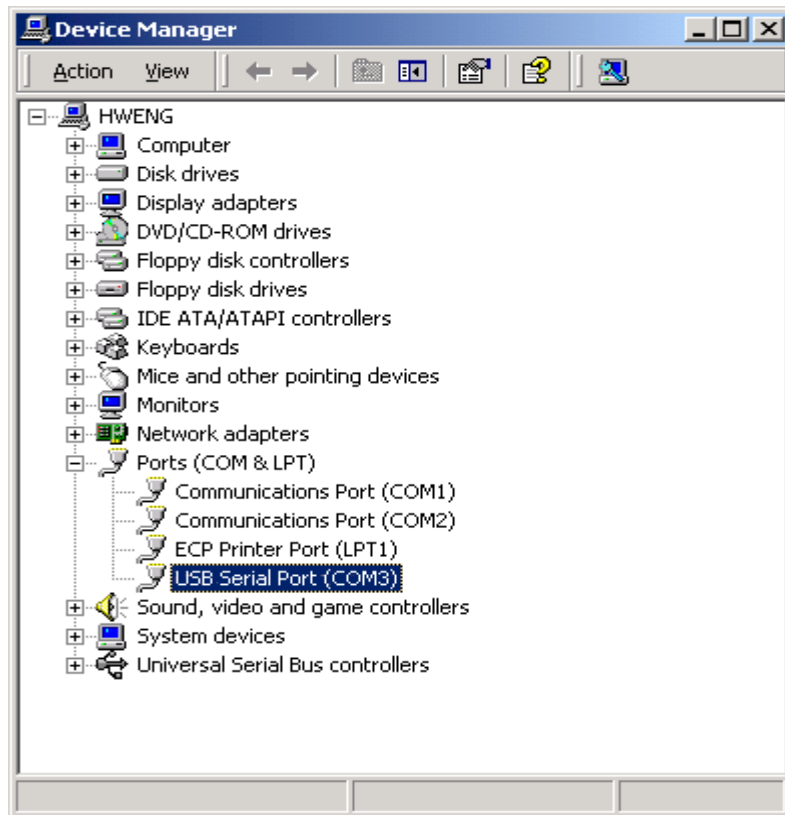
It will find the driver and install it.



The USB Serial Port driver is installed in Windows 2000<sup>®</sup> now.



You can check the Com port number of the Sapphire from Device Manager.  
It is COM3 in  
this example.



Step 3: Place your Sapphire on the outside roof of your vehicle with magnetic base.

Step 4: Power on your Notebook PC or Handheld PC.

Step 5: Choose the correct COM port for running the map or navigation software.

Step 6: Run the Sapphire test program. Please refer to “**How to test your Sapphire**”.

Notice:

- (1) Make sure the power is off before started.
- (2) For safety reason, please do not install Sapphire while driving.
- (3) To receive NMEA0183 navigational data, please use the Hyper Terminal program of Windows 2000®. Please setup the COM port connected with Sapphire to:

|              |         |
|--------------|---------|
| Baud rate    | : 4800  |
| Data bit     | : 8     |
| Parity       | : None  |
| Stop bit     | : 1     |
| Flow control | : None. |



- (4) NMEA 0183 data formats are illustrated on Software Data section.
- (5) To prevent the poor contact, the 4-pin mini din connector was designed as good fitting. We strongly recommend user that do not plug and draw this connector frequently.

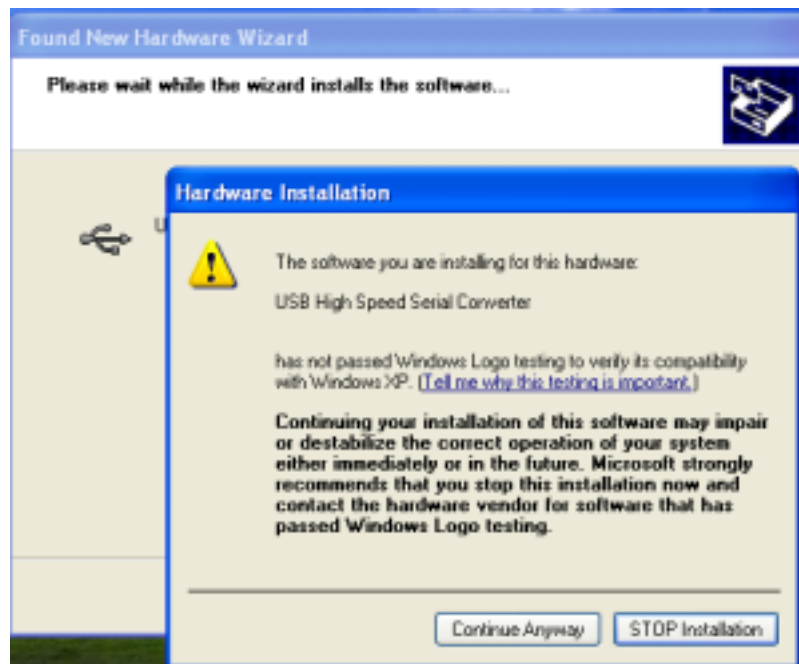
# How to Install & Operate Sapphire ( USB ) for Windows XP®?

Step 1: Plug USB connector (①) to USB port to your Notebook PC or Handheld PC and insert CD supported by Royaltek.

Step 2: After plug in the Sapphire, it will detect the hardware automatically. Please select the “Install the software automatically [Recommended]”. Click the “Next>” button.



Please select “Continue Anyway” and Click this button.



Please select the “Finish”. Click “Next>” button.

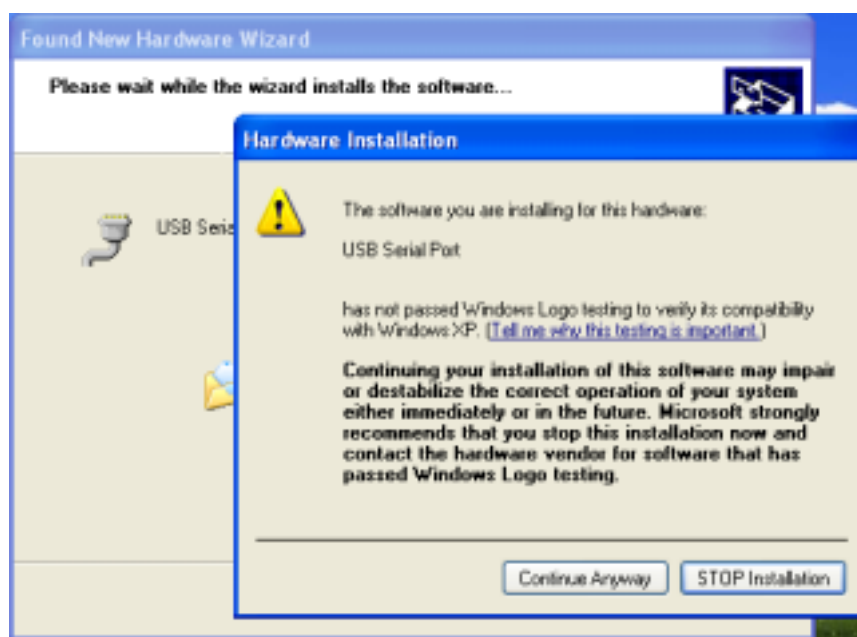


The USB Serial driver is installed in Windows XP<sup>®</sup> now. Please wait for about one minute.

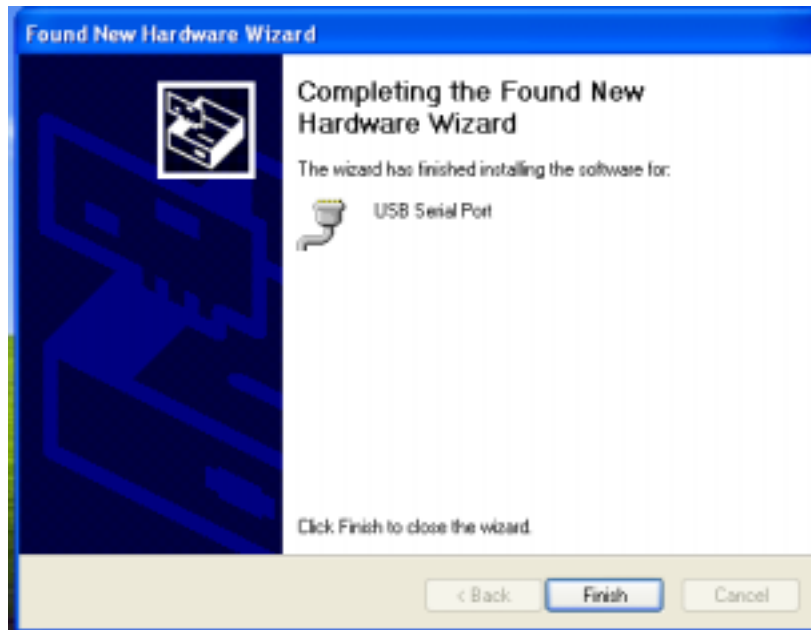
It will setup the USB Serial port driver for Sapphire. Please select the “Install the software automatically [Recommended]”. Click “Next>” button.



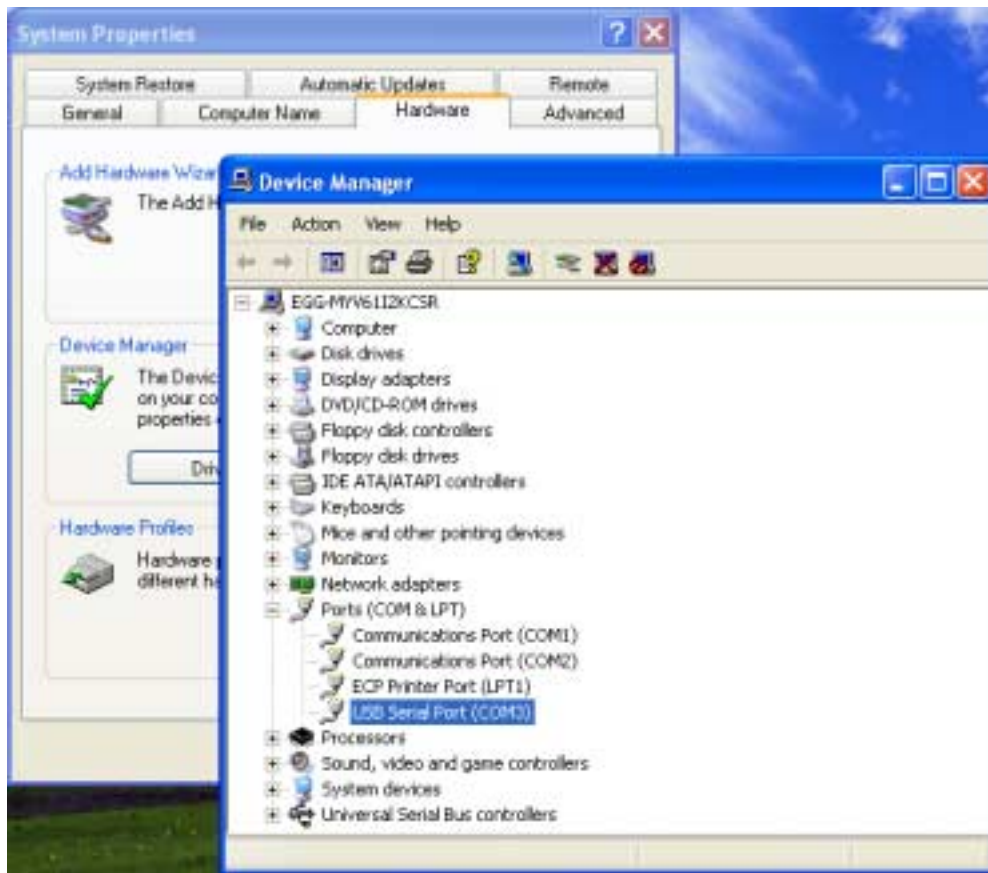
Please select “Continue Anyway” and Click this button.



The USB Serial Port driver is installed in Windows XP® now.



You can check the Com port number of the Sapphire from Device Manager. It is COM3 in this example.



Step 3: Place your Sapphire on the outside roof of your vehicle with magnetic base.

Step 4: Power on your Notebook PC or Handheld PC.

Step 5: Choose the correct COM port for running the map or navigation software.

Step 6: Run the Sapphire test program. Please refer to “**How to test your Sapphire**”.

Notice:

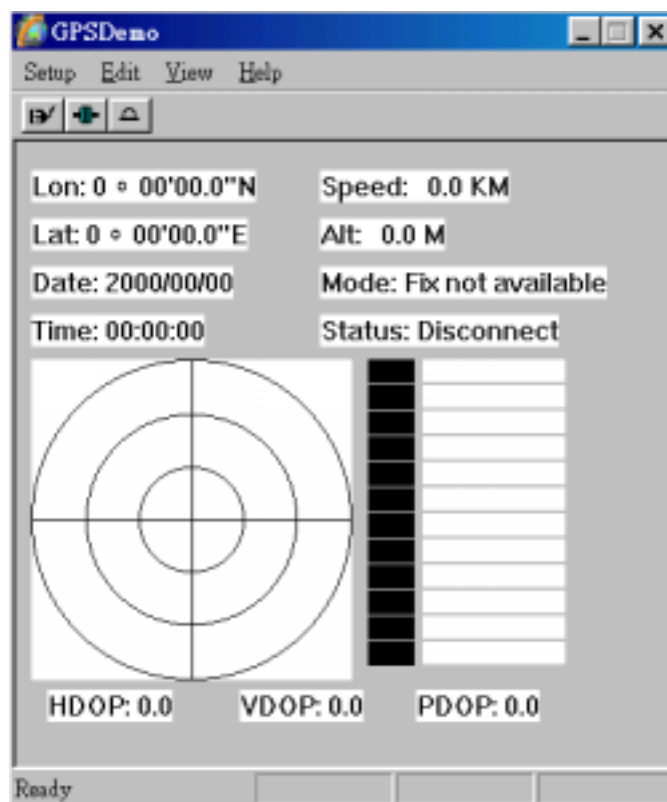
- (1) Make sure the power is off before started.
- (2) For safety reason, please do not install Sapphire while driving.
- (3) To receive NMEA0183 navigational data, please use the Hyper Terminal program of Windows 2000®. Please setup the COM port connected with Sapphire to:

|              |         |
|--------------|---------|
| Baud rate    | : 4800  |
| Data bit     | : 8     |
| Parity       | : None  |
| Stop bit     | : 1     |
| Flow control | : None. |


- (4) NMEA 0183 data formats are illustrated on Software Data section.
- (5) To prevent the poor contact, the 4-pin mini din connector was designed as good fitting. We strongly recommend user that do not plug and draw this connector frequently.

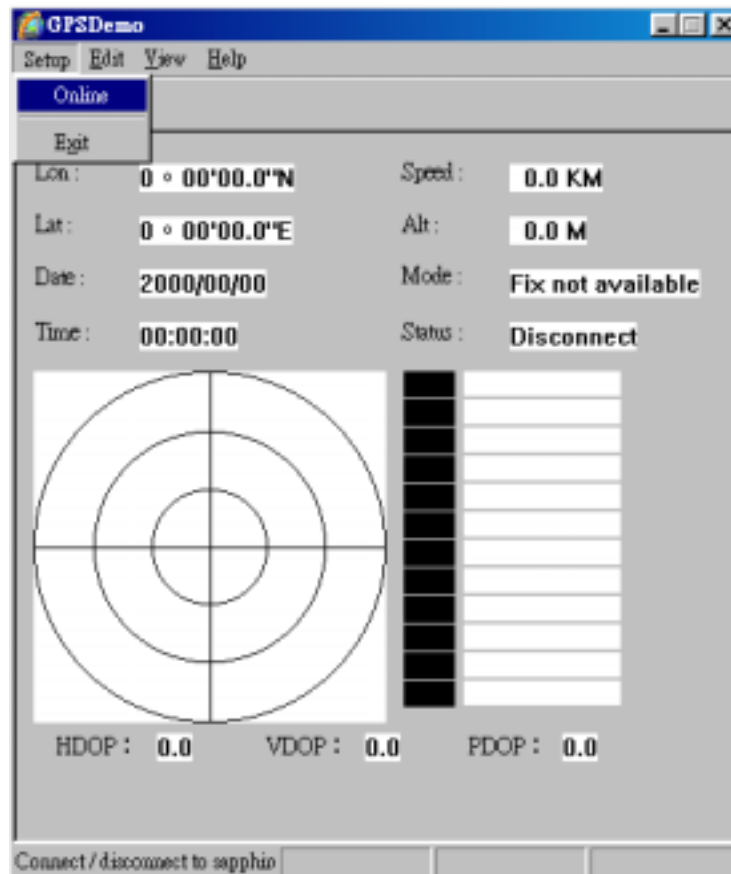
# How to test your Sapphire

1. Run the test program by double clicking the \Test programs\GPSDemo.exe file.  
Then the test program will automatically install into your computer.
2. Run the testing program by clicking the shortcut on your Window's program group.
3. Testing program will display as follow:

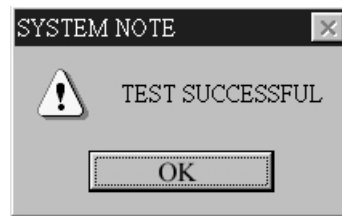




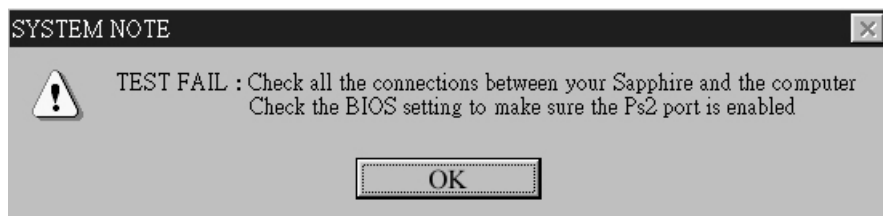
4. Before running the test program, make sure you have connected Sapphire to the PC correctly.
5. Click the icon  on toolbar or click the Start test on the Setup menu. Then the program will automatically detect the serial port and start testing.



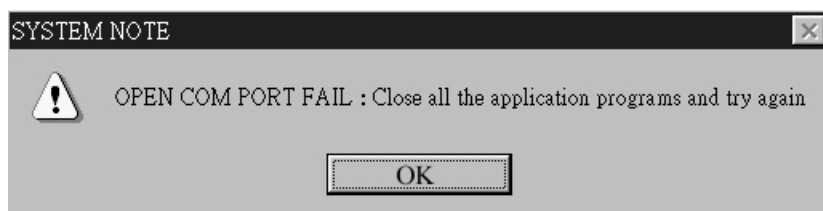
6. When finish the test, there is a message box showing the test result. If the test is successful, it will show the following message:



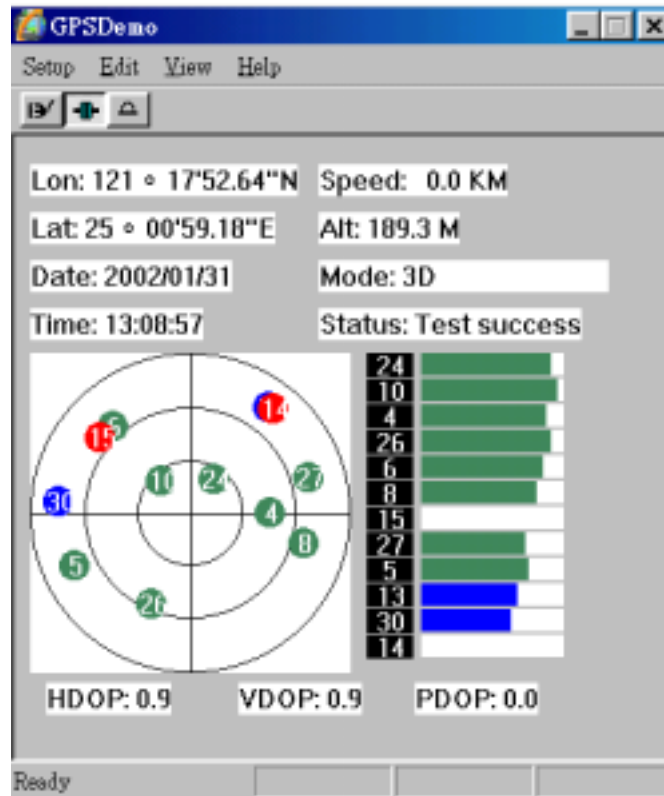
If the test fails, it will show the following message:



If it cannot open the COM port, it will show the following message:



7.If the GPS connection is successful, you can see the satellite tracking diagram and the updated data of longitude, latitude, altitude, date time etc.



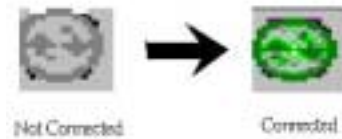
# How to Synchronize your PDA

Run the msaync890725.exe in the CD path(PDA synchronization \ msaync890725.exe)

After installation, double click the “Microsoft ActiveSync” icon.



Put the PDA on the cradle, then you will see the icon on the task bar from:



## Physical characteristics

Dimension: 62+/-0.5 mm (L) x 50+/-0.5 mm (W) x 28+/-0.5 mm (H)

Weight 180 grams

## Temperature characteristics

Storage temperature: -10°C ~ +85°C.

Operating temperature: 0°C ~ +70°C.

## General

|          |                     |
|----------|---------------------|
| Channels | 12 channels         |
| L1       | 1575.42 MHz.        |
| C/A code | 1.023MHz chip rate. |

## Accuracy

Position accuracy : 25m, CEP without SA.

Velocity accuracy : 0.1 meter / second without SA

## **Datum**

WGS-84.

## **Position update rate**

Once per second.

## **Dynamic conditions**

Altitude : 18000 meters (60000 feet) max.

Velocity : 514 meters / second max.

Jerk : 20 meters / second<sup>3</sup>, max.

Acceleration : 4 G, max.

## **Power**

PS2/USB input power: DC 5V  $\pm$  5 %, 180mA, typical

Car cigarette power adaptor: +9V ~ +16V.

## **Certification**

FCC/CE compliant

# Software Data

## NMEA V2.2 Protocol

It is the RS-232 interface : 4800 bps, 8 bit data, 1 stop bit and no parity.

### NMEA Output Messages

The Sapphire outputs the following messages as shown in Table 1 :

**TABLE 1 NMEA OUTPUT MESSAGES**

| NMEA Record | Description                            |
|-------------|--|
| GGA         | Global positioning system fixed data   |
| GSA         | GNSS DOP and active satellites         |
| GSV         | GNSS satellites in view                |
| RMC         | Recommended minimum specific GNSS data |

### GGA – Global Positioning System Fixed Data

Table 2 contains the values of the following example :

\$GPGGA, 161229.487, 3723.2475, N, 12158.3416, W, 1, 07, 1.0, 9.0, M, , , 0000\*18

**TABLE 2 GGA DATA FORMAT**

| Name                   | Example    | Units  | Description                       |
|------------------------|------------|--------|-----------------------------------|
| Message ID             | \$GPGGA    |        | GGA protocol header               |
| UTC Position           | 161229.487 |        | hhmmss.sss                        |
| Latitude               | 3723.2475  |        | ddmm.mmmm                         |
| N/S Indicator          | N          |        | N=north or S=south                |
| Longitude              | 12158.3416 |        | dddmm.mmmm                        |
| E/W Indicator          | W          |        | E=east or W=west                  |
| Position Fix Indicator | 1          |        | See Table 5-1                     |
| Satellites Used        | 07         |        | Range 0 to 12                     |
| HDOP                   | 1.0        |        | Horizontal Dilution of Precision  |
| MSL Altitude           | 9.0        | meters |                                   |
| Units                  | M          | meters |                                   |
| Geoid Separation       |            | meters |                                   |
| Units                  | M          | meters |                                   |
| Age of Diff. Corr.     |            | second | Null fields when DGPS is not used |
| Diff. Ref. Station ID  | 0000       |        |                                   |
| Checksum               | *18        |        |                                   |
| <CR> <LF>              |            |        | End of message termination        |

**TABLE 2-1 POSITION FIX INDICATOR**

| Value | Description                           |
|-------|---------------------------------------|
| 0     | Fix not available or invalid          |
| 1     | GPS SPS Mode, fix valid               |
| 2     | Differential GPS, SPS Mode, fix valid |
| 3     | GPS PPS Mode, fix valid               |

## **GSA — GNSS DOP and Active Satellites**

Table 3 contains the values of the following example :

\$GPGSA, A, 3, 07, 02, 26, 27, 09, 04, 15, , , , , 1.8,1.0,1.5\*33

**TABLE 3 GSA DATA FORMAT**

| Name                        | Example | Units | Description                      |
|-----------------------------|---------|-------|----------------------------------|
| Message ID                  | \$GPGSA |       | GSA protocol header              |
| Mode 1                      | A       |       | See Table 3-2                    |
| Mode 2                      | 3       |       | See Table 3-1                    |
| Satellite Used <sup>1</sup> | 07      |       | Sv on Channel 1                  |
| Satellite Used <sup>1</sup> | 02      |       | Sv on Channel 2                  |
| ....                        |         |       | ....                             |
| Satellite Used <sup>1</sup> |         |       | Sv on Channel 12                 |
| PDOP                        | 1.8     |       | Position Dilution of Precision   |
| HDOP                        | 1.0     |       | Horizontal Dilution of Precision |
| VDOP                        | 1.5     |       | Vertical Dilution of Precision   |
| Checksum                    | *33     |       |                                  |
| <CR> <LF>                   |         |       | End of message termination       |



**TABLE 3-1 MODE 1**

| Value | Description       |
|-------|-------------------|
| 1     | Fix not available |
| 2     | 2D                |
| 3     | 3D                |

**TABLE 3-2 MODE 2**

| Value | Description                                       |
|-------|---|
| M     | Manual — forced to operate in 2D or 3D mode       |
| A     | Automatic — allowed to automatically switch 2D/3D |

## GSV — GNSS Satellites in View

Table 4 contains the values of the following example :

\$GPGSV, 2, 1, 07, 07, 79, 048, 42, 02, 51, 062, 43, 26, 36, 256, 42, 27, 27, 138, 42\*71

**TABLE 4 GSV DATA FORMAT**

| Name                            | Example | Units   | Description                           |
|---------------------------------|---------|---------|---------------------------------------|
| Message ID                      | \$GPGSV |         | GSV protocol header                   |
| Number of Messages <sup>1</sup> | 2       |         | Range 1 to 3                          |
| Messages Number <sup>1</sup>    | 1       |         | Range 1 to 3                          |
| Satellites in View              | 07      |         |                                       |
| Satellite ID                    | 07      |         | Channel 1(Range 1 to 32)              |
| Elevation                       | 79      | degrees | Channel 1(Maximum 90)                 |
| Azimuth                         | 048     | degrees | Channel 1(True, Range 0 to 359)       |
| SNR (C/No)                      | 42      | dBHz    | Range 0 to 99, null when not tracking |
| ....                            |         |         | ....                                  |
| Satellite ID                    | 27      |         | Channel 4(Range 1 to 32)              |
| Elevation                       | 27      | degrees | Channel 4(Maximum 90)                 |
| Azimuth                         | 138     | degrees | Channel 4(True, Range 0 to 359)       |
| SNR (C/No)                      | 42      | dBHz    | Range 0 to 99, null when not tracking |

|           |     |  |                            |
|-----------|-----|--|----------------------------|
| Checksum  | *71 |  |                            |
| <CR> <LF> |     |  | End of message termination |


## RMC – Recommended Minimum Specific GNSS Data

Table 5 contains the values of the following example : \$GPRMC, 161229.487, A, 3723.2475, N, 12158.3416, W, 0.13, 309.62, 120598, ,\*10

**TABLE 5 RMC DATA FORMAT**

| Name               | Example    | Units   | Description                      |
|--------------------|------------|---------|----------------------------------|
| Message ID         | \$GPRMC    |         | RMC protocol header              |
| UTC Position       | 161229.487 |         | hhmmss.sss                       |
| Status             | A          |         | A=data valid or V=data not valid |
| Latitude           | 3723.2475  |         | ddmm.mmmm                        |
| N/S Indicator      | N          |         | N=north or S=south               |
| Longitude          | 12158.3416 |         | dddmm.mmmm                       |
| E/W Indicator      | W          |         | E=east or W=west                 |
| Speed Over Ground  | 0.13       | knots   |                                  |
| Course Over Ground | 309.62     | degrees | True                             |
| Date               | 120598     |         | ddmmyy                           |
| Magnetic Variation |            | degrees | E=east or W=west                 |
| Checksum           | *10        |         |                                  |
| <CR> <LF>          |            |         | End of message termination       |

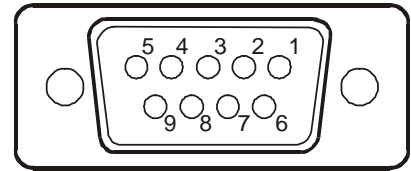
# Troubleshooting

| Problem  | Reason  | Solution  |
|--|---|---|
| Test fail  | Poor connection   | Check the RS232 and PS2 connector or USB connector to make sure they are well connected.  |
|  | Wrong BIOS setting for PS2  | Check the BIOS setting to make sure the PS2 port is enable.<br><br>If you still get the testing fail message, contact your local distributor.                                       |
| Open com port fail   | All the serial COM port have been used for other application program  | Close all the other application programs and rerun the Sapphire Testing program.  |
| There is nothing showing on the tracking diagram even if the test result is success. | Sapphire can not receive the GPS signal on the testing area.  | Move Sapphire to somewhere there is exposed to outdoors.<br><br>Note: normally we cannot receive the GPS signal indoors.  |
| No position output but timer is counting   | 1.Weak or no GPS signal can be received at the place Sapphire are.<br><br>2.At outdoor space but GPS signal is block by buildings | Go outdoor place without high building to block the signal and retest the Sapphire again.   |
| If operated Sapphire over 5 minutes with nothing showing on the tracking diagram     | Maybe Sapphire received not enough data to sure tracking.   | Utilize the test program --- GPSDemo.exe to reset Sapphire. Please Click the icon  on toolbar. |

## Appendix : Connector Interface

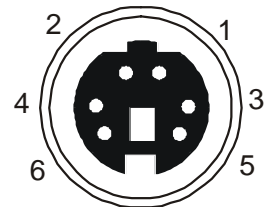
### 9 pin D-SUB

| Pin NO | Signal Name | I/O | Description        | Characteristics                     |
|--------|-------------|-----|--------------------|-------------------------------------|
| 1      | No connect  |     |                    |                                     |
| 2      | TX          | O   | Serial Data Output | High: -3V ~ -15V<br>Low: +3V ~ +15V |
| 3      | RX          | I   | Serial Data Input  | High: -3V ~ -15V<br>Low: +3V ~ +15V |
| 4      | No connect  |     |                    |                                     |
| 5      | GND         | G   | Ground             |                                     |
| 6      | No connect  |     |                    |                                     |
| 7      | No connect  |     |                    |                                     |
| 8      | No connect  |     |                    |                                     |
| 9      | No connect  |     |                    |                                     |



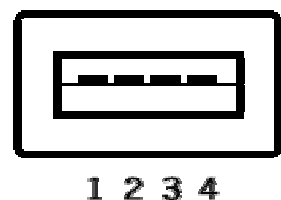
### 6 pin mini din

| Pin NO | Signal Name | I/O | Description        | Characteristics   |
|--------|-------------|-----|--------------------|-------------------|
| 1      | No connect  |     |                    |                   |
| 2      | No connect  |     |                    |                   |
| 3      | GND         | G   | Ground             |                   |
| 4      | VCC         | I   | +5V DC Power Input | DC +5V $\pm$ 10%. |
| 5      | No connect  |     |                    |                   |
| 6      | No connect  |     |                    |                   |



### USB A Type Connector

| Pin NO | Signal Name | I/O | Description        | Characteristics    |
|--------|-------------|-----|--------------------|--------------------|
| 1      | GND         | -   | Ground             | Ground             |
| 2      | D+          | I/O | Data plus          | Data plus          |
| 3      | D-          | I/O | Data Minus         | Data Minus         |
| 4      | VCC         | +   | +5V DC Power Input | +5V DC Power Input |



## Limited Warranty

RoyalTek Company Ltd. grants a warranty for this product for one year starting from the date of purchasing of the product. Please retain the sales receipt as proof of purchase. During the warranty period, the product is eligible for replacement in case of defects in material and workmanship. In such case, the defective unit will be repaired or replaced according to an assessment by RoyalTek. However this warranty does not cover damages caused by improper use or from unauthorized modifications by third parties. In addition, this warranty does not cover expendable materials and defects, which constitute as normal wear or tear. Please contact us as following:

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